

Impact of dining out on nutritional intake and metabolic syndrome risk factors: data from the 2011 Korean National Health and Nutrition Examination Survey

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Abstract

The frequency of dining out has rapidly increased; however, the independent associations between dining out, metabolic syndrome risk factors and nutritional status have not been well characterised. The aim of the present study was to investigate the associations between dining out, nutritional intakes and metabolic syndrome risk factors among Korean adults, using data from the 2011 Korean National Health and Nutrition Examination Survey. Frequency of dining out was significantly associated with intake of nutrients such as energy, water, protein, fat, carbohydrate, Ca, Na, vitamin A and carotene. Especially, the result revealed that Korean adults had insufficient Ca intake compared with the Korean reference intake (700 mg). As the frequency of dining out increased, so did energy intake. In addition, individuals who dined out seven or more times per week experienced a 64% higher likelihood of blood pressure abnormalities, an 88% higher likelihood of waist circumference abnormalities, and a 32% higher likelihood of low HDL-cholesterol levels than those who dined out less than once per week. BMI was not associated with the frequency of dining out. Our findings suggest that strategies to modify dining-out behaviour could reduce metabolic syndrome risk factors via improved nutrition.

Key words: Dining-out frequency; Metabolic syndrome risk factors; Nutritional intake; Korean National Health and Nutrition Examination Survey

Income growth, consumer preference shifts and a transitioning economy have dramatically changed the Korean diet⁽¹⁾. In particular, the frequency of dining out has risen rapidly as a result of numerous factors, including the participation of females in economic activities, changes in the Korean lifestyle, such as getting more leisure time as a result of the 5 d workweek, and a desire for convenience⁽²⁾. Consequently, the restaurant industry has expanded greatly, reporting a large increase in sales: from 28 trillion won in 1996 to 42 trillion won in 2003, and 70 trillion won in 2009 in Korea⁽²⁾. Recently, dining-out behaviour has been recognised as an important risk factor for nutritional imbalance and metabolic diseases, such as obesity and diabetes⁽³⁾. In the USA, food prepared outside the home, in places such as fast food and casual-dining restaurants, is generally higher in energy and less healthful than food prepared at home⁽⁴⁾. In light of the effect that dining-out behaviour has on health, adolescents should be aware of their own dining-out behaviour. A national survey from the USA⁽⁵⁾ has

found that the Western pattern of diet, characterised by frequent dining out, a high intake of red and processed meats, refined grains, high-fat dairy products, and sweets and desserts, is associated with an increased risk of metabolic disorders, CHD, cancer and even mortality. A study conducted in European countries has reported that frequent dining out may lead an individual to exceed dietary recommendations for fat, Na, carbohydrates and other nutrients; at the same time, it may lead to a low intake of important nutrients⁽⁶⁾. To promote optimum health in Koreans aged 20 years and above, the Dietary Reference Intakes for Koreans (KDRI) recommend three servings of grains, two servings of milk/milk products, four servings of meats and beans, two servings of fruits, five servings of vegetables, and four servings of fat and sweets per d⁽⁷⁾. In the globalised foodservice market, consumers are mainly interested in healthy and well-being food. In addition, they are more interested in fresh ingredients as well as the dietary profiles of meals. A few studies have demonstrated an association between dining-out frequency

Abbreviations: KDRI, Dietary Reference Intakes for Koreans; KNHANES, Korean National Health and Nutrition Examination Survey; WC, waist circumference.

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and BMI or weight gain⁽⁸⁾, and no studies have yet focused on the association between dining out, metabolic syndrome risk factors and nutritional status. Therefore, in the present study, we investigated the patterns of dining out and metabolic syndrome risk factors in adults aged 20 years and over using data from the 2011 Korean National Health and Nutrition Examination Survey (KNHANES) to identify the potentially serious effects of dining out on nutritional status and metabolic syndrome risk factors among Korean adults.

Methods

Study sample

The data used in the present study was acquired from the 2011 KNHANES that samples non-institutionalised Korean civilians. In brief, the 2011 KNHANES consisted of four components: a health interview; a health behaviour survey; a health examination; a nutrition survey⁽⁹⁾. Using a stratified, multi-stage probability sampling design, a total of 10 589 individuals were selected for the 2011 KNHANES⁽¹⁰⁾. Subjects aged 20 years or older who had completed the health examination and the nutrition survey were included in the present study. Exclusion criteria included implausibly low or high daily energy intake reports (<2092 or >20 920 kJ/d). This resulted in a final sample of 5500 subjects.

Ethics

All the participants in the KNHANES were informed that they had been randomly chosen to participate in the survey with the right to refuse to be involved in further analyses, and signed an informed consent form. As the KNHANES data are available publicly, ethical approval was not required for the present study.

Measurements

Waist circumference (WC), height and weight were measured using standardised techniques and calibrated equipment. BMI was calculated as weight (kg)/height² (m²). Blood pressure was measured using a sphygmomanometer (Baumanometer; W.A. Baum Co., Inc.) with the subject in a sitting position. First, three consecutive blood pressure measurements were performed on all subjects at 5 min intervals, and then the average of the second and third measurements was used in the analysis. Blood samples were collected in the morning after the subjects had fasted for at least 8 h. Fasting insulin levels were measured by immunoradiometric assay (Biosource) using a g-counter (1470 Wizard; PerkinElmer). Total cholesterol, TAG and HDL-cholesterol concentrations were analysed in a central, certified laboratory using a Hitachi Automatic Analyzer 7600. A general questionnaire was administered to collect basic demographic and health-related information. Smoking status was assessed by asking whether participants were current smokers. Age (in years) was classified into six categories: 20s, 30s, 40s, 50s, 60s and 70+. Marital status was divided into three categories: married; widowed/

divorced; single. Family income was categorised as: <500 000 won; 500 000–1 500 000 won; >1 500 000 won. The highest educational level achieved was categorised as: elementary school or less; middle school; high school; college. Occupational status was classified as: non-physical; physical; 'other'. Subjective body image was categorised as: underweight; normal; overweight. BMI was categorised as: underweight (BMI <18.5 kg/m²); normal (18.5 ≤ BMI ≤ 24.9 kg/m²); overweight (BMI >25.0 kg/m²). Diabetes status was categorised as: normal; prediabetes; diabetes. Physical activity data were gathered by asking whether participants had engaged in moderate-intensity physical activity 5 d or more over the previous week that had lasted for 20 min or more. Moderate-intensity physical activity includes sporting activities such as swimming, doubles tennis, volleyball, badminton and table tennis for at least 30 min once, more than 5 d per week except for just walking and professional activities such as carrying light stuff and activities that lead to a little more shortness of breath or difficult to breathe than usual. Moderate-intensity physical activity was defined by Haskell *et al.*⁽¹¹⁾. A question on dining-out frequency asked about meals prepared outside the home, including restaurant food, delivery food, take-out food, foodservice, etc. Dining-out frequency was measured based on a 1-week period. Dietary intake was measured using the single 24 h dietary recall method. A trained staff instructed the respondents to recall and describe all foods and beverages consumed in the previous day. Food models and measuring bowls, cups and spoons were used to assist in estimating portion sizes. The method used herein was obtained from the 2011 KNHANES⁽¹⁰⁾.

Definition of metabolic syndrome risk factors

We employed the original criteria for the metabolic syndrome proposed by the National Cholesterol Education Program Adult Treatment Panel III. However, we used ethnicity-specific WC values, as proposed by the International Diabetes Federation (IDF). Obesity was assessed based on the BMI cut-offs proposed by the WHO. Abdominal obesity was defined as WC >90 cm in males and >80 cm in females; hypertriglycerolaemia as TAG ≥ 1.7 mmol/l; low HDL-cholesterol as <1.0 mmol/l in males and <1.3 mmol/l in females; hypertension as blood pressure ≥ 130/85 mmHg; hyperglycaemia as fasting plasma glucose level ≥ 6.11 mmol/l⁽⁹⁾.

Statistical analysis

All statistical analyses were conducted using SPSS 20.0 for Windows (SPSS, Inc.). The associations between socioeconomic characteristics and dining-out frequency were assessed by the χ^2 test. General linear models were constructed to assess the associations between dining-out frequency and nutrient intakes. Logistic regression models were used to calculate OR with 95% CI for the associations between dining-out frequency and metabolic syndrome risk factors. An association was considered statistically significant if the *P* value was <0.05.



Results

Table 1 presents the socio-economic characteristics stratified by dining-out frequency. Most subjects (70.1%) dined out once or more per week. Dining-out frequency was significantly associated with sex, age, family income, education level, occupation, subjective body image, smoking status, marital status and diabetes status. Males dined out more frequently than females ($P < 0.001$), and younger people dined out more frequently than older people ($P < 0.001$). In terms of family income, lower income showed different distribution trends from the other two groups (500 000–1 500 000 and >1 500 000). Respondents who were employed in physical occupations or those who were non-smokers, married, had an obese body image, or had higher levels of education dined out more frequently.

Table 2 presents the nutrient intakes stratified by dining-out frequency. There were significant associations between nutrition intakes and dining out. As dining-out frequency increased, so did energy intake. Males aged 65 years or over took less energy than recommended (KDRI: 8368 kJ), as did

females aged 65 years or over (KDRI: 6694 kJ). In individuals aged 65 years or over, an increase in dining-out frequency was not associated with an increase in energy intake. In males aged 20–65 years, energy intake was adequate (KDRI: 9205–10 878 kJ), though energy intake in females aged 20–65 years was insufficient (KDRI: 7531–8786 kJ). Water, fat and Na intake increased with dining-out frequency. Ca intake was significantly lower than recommended (KDRI: 700 mg) in the sample as a whole.

Adjusted OR and 95% CI for metabolic syndrome risk factors according to dining-out frequency are presented in Table 3. Individuals who dined out seven or more times per week exhibited a 64% higher likelihood of blood pressure abnormalities, an 88% higher likelihood of WC abnormalities, and a 32% lower likelihood of low HDL-cholesterol levels than those who dined out less than once per week. BMI was not associated with dining-out frequency. We investigated other criteria for the metabolic syndrome, as proposed by the WHO, the IDF and the updated ATP III, but found no associations with dining out (data not shown).

Table 1. Percentage of the Korean adults with given socio-economic characteristics, stratified by dining-out frequency

Variables	Group	Dining-out frequency (per week)					P*
		None (n 2052)	1–2 (n 1240)	3–4 (n 453)	5–6 (n 701)	≥7 (n 1054)	
Sex	Male	19.7	14.0	8.1	18.9	39.2	<0.000
	Female	39.6	26.4	9.5	10.7	13.9	
Age (years)	20–29	7.0	15.6	12.5	17.1	47.7	<0.000
	30–39	13.4	19.6	18.9	21.5	36.6	
	40–49	17.9	16.4	8.6	19.6	37.5	
	50–59	31.7	20.8	7.2	15.1	25.2	
	60–69	57.1	18.9	8.1	8.1	7.8	
	70+	70.5	18.1	3.4	4.4	3.7	
Family income (won/month)†	< 500 000	29.6	18.6	8.2	15.8	27.8	<0.000
	500 000–1 500 000	13.8	17.6	9.6	17.8	41.2	
	> 1 500 000	18.1	13.8	8.4	17.0	42.5	
Educational level	Elementary	64.5	16.6	4.9	6.3	7.7	<0.000
	Middle school	39.7	20.7	8.7	12.3	18.6	
	High school	20.1	18.3	9.8	18.1	33.7	
	College	10.9	18.1	9.3	19.1	42.6	
Marital status	Married	29.3	19.4	7.4	16.5	27.4	<0.000
	Widowed/divorced	52.8	18.0	8.5	7.7	12.9	
	Single	75.5	0	24.5	0	0	
Occupation	Non-physical	6.7	9.8	8.8	25.2	49.5	<0.000
	Physical	26.4	16.4	7.9	17.8	31.6	
	Other‡	42.5	27.7	9.6	5.6	14.7	
Subjective body image	Underweight	29.4	14.6	8.8	14.1	33.0	<0.022
	Normal	28.4	19.3	8.5	16.4	27.4	
	Overweight	23.1	18.8	8.8	16.2	33.1	
Smoking status	Yes	19.9	13.2	8.6	19.2	39.1	<0.000
Physical activity§	Yes	28.6	16.9	8.9	15.7	29.8	0.907
BMI (kg/m ²)	Underweight	32.1	13.9	12.8	18.2	23.1	0.180
	Normal	26.3	19.1	8.5	15.9	30.2	
	Overweight	26.2	16.9	8.3	16.2	32.4	
Diabetes¶	Normal	23.6	18.8	9.1	15.9	32.7	<0.000
	Prediabetes	26.8	17.9	7.5	16.0	31.8	
	Diabetes	42.6	15.6	8.2	13.4	20.2	

* P values were obtained from the χ^2 test.

† 1000 Korean won equals to 1 US dollar.

‡ Including students, housewives and the unemployed.

§ 'Yes' indicates subjects who were engaged in moderate-intensity physical activity 5 d or more over the previous week that lasted for 20 min or more.

|| Underweight, BMI < 18.5 kg/m²; normal, BMI 18.5–24.9 kg/m²; overweight, BMI > 25.0 kg/m².

¶ Prediabetes, fasting glucose level 5.6–6.9 mmol/l; diabetes, diagnosed with diabetes or fasting glucose level ≥ 7.0 mmol/l.

Table 2. Nutrient intakes among the Korean adults, stratified by dining-out frequency (Mean values and standard deviations)

Nutrients	Dining-out frequency (per week)															P*
	None			1-2			3-4			5-6			≥7			
	Mean	SD		Mean	SD		Mean	SD		Mean	SD		Mean	SD		
Energy (kJ)	8033.57	45.49		8276.83	47.86		9118.40	61.47		8882.97	55.41		9302.58	51.01		0.000
Water (g)	879.98	31.88		936.08	33.35		1090.55	49.33		975.26	42.37		1104.67	47.57		0.000
Protein (g)	68.11	2.68		70.09	2.55		79.40	2.92		74.45	3.11		78.97	2.62		0.002
Fat (g)	36.64	1.70		38.15	1.52		45.94	2.06		45.31	1.94		47.23	1.99		0.000
Carbohydrates (g)	311.41	7.67		313.29	8.35		332.68	10.79		331.93	7.57		338.23	8.00		0.004
Ca (mg)	471.52	16.49		484.74	17.03		548.76	25.67		499.10	20.33		562.51	21.67		0.000
Na (mg)	4546.46	182.31		4733.98	182.35		5159.42	229.93		5079.47	192.77		5429.36	189.34		0.002
Vitamin A (µg RE)	721.583	49.50		764.38	48.49		859.93	64.13		807.00	58.27		865.09	54.89		0.005
Carotene (µg)	3678.79	269.49		3802.20	225.26		4357.06	358.35		3991.39	300.57		4304.41	295.10		0.028

KDRI, Dietary Reference Intakes for Koreans; RE, retinol equivalents.

* P values were obtained from general linear models that were adjusted for age, sex, smoking and diabetes.

† Values were obtained from the 2010 KDRI.

Discussion

The present study found that dining-out frequency was positively associated with metabolic syndrome risk factors such as increasing the risk of the abnormalities of blood pressure, WC and HDL-cholesterol in Koreans aged 20 years and older, and intake of nutrients such as energy, water, protein, fat, carbohydrate, Ca, Na, vitamin A and carotene. Especially, the result revealed that Korean adults had insufficient Ca intake compared with the Korean reference intake (700 mg). Due to lifestyle changes in Korea, especially dining-out behaviour and a shift towards Westernised and convenient foods, it is possible that nutritional status is deteriorating at the national level. Recently, concerns about the associations between the nutritional quality of meals outside the home and metabolic diseases have increased; dining-out behaviour is recognised as an important factor in disease prevention and making people's lives healthier. However, to date, few studies have focused on dining out and health factors. The goal of the present study was to draw people's attention to their dining-out behaviour. We found that dining-out frequency was positively associated with metabolic syndrome risk factors. However, we did not identify a positive association between dining-out frequency and obesity or BMI. In the past, BMI has been used as a surrogate for obesity; however, it is now generally considered an insensitive index due to the fact that individuals of similar weight may have considerably different levels of fat or muscle mass⁽¹²⁾. Our findings suggest that WC is a more important metabolic syndrome risk factor than BMI.

We also found that subjects with a greater frequency of dining out had higher intakes of energy, fat and Na. One interesting finding in the present study was that, in contrast to younger individuals, increased energy intake was not directly proportional to dining-out frequency in participants aged 65 years and over (data not shown). This may be attributed to changes in taste that occur with age or the impairment of teeth and body functions. In the globalised food service market, increased elderly consumers play a key role in setting food industry trends such as more healthy and well-being food.

The Korean Nutrition Society revised the KDRI in 2010 and released a new nutritional model, the Food Balance Wheel⁽¹³⁾, to replace the Food Pyramid. It emphasises the importance of water and protein intake, and exercise⁽¹⁴⁾. We found that water and protein intake increased with dining-out frequency, but there were no significant associations between dining out and exercise. According to Wing⁽¹⁵⁾, people who participate in regular physical activity practise better health maintenance and are better at adhering to a healthy diet. We found that frequency of dining out was significantly associated with intake of nutrients such as energy, water, protein, fat, carbohydrate, Ca, Na, vitamin A and carotene. Especially, the result revealed that Korean adults had insufficient Ca intake compared with the Korean reference intake (700 mg). These findings are consistent with those of a recent national survey, which revealed serious Ca deficiency among Koreans and demonstrated its association with chronic disease⁽¹⁴⁾. Issues regarding the nutritional imbalance of food prepared outside the home have been discussed in several studies.

Table 3. Metabolic syndrome risk factors among the Korean adults, according to dining-out frequency† (Odds ratios and 95 % confidence intervals)

Variables	Dining-out frequency (per week)									
	None		1–2		3–4		5–6		≥ 7	
	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
Elevated blood pressure‡	1.00	1.129	0.796, 1.602	1.296	0.786, 2.137	1.395	0.956, 2.037	1.641**	1.168, 2.305	
Obesity§	1.00	0.928	0.734, 1.175	0.989	0.705, 1.388	0.953	0.730, 1.243	1.107	0.880, 1.391	
Abdominal obesity	1.00	1.024	0.741, 1.415	1.840**	1.275, 2.656	1.477**	1.108, 1.971	1.882***	1.438, 2.464	
High fasting glucose¶	1.00	2.244*	1.063, 4.737	2.102	0.821, 5.379	6.717***	2.401, 18.792	0.780	0.424, 1.434	
Hypertriglycerolaemia††	1.00	1.147	0.880, 1.496	0.970	0.676, 1.394	1.355	0.978, 1.878	1.048	0.791, 1.387	
HDL-cholesterol‡‡	1.00	1.058	0.803, 1.394	0.793	0.535, 1.175	0.640**	0.465, 0.881	0.677**	0.522, 0.878	

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

† Logistic models used to calculate the OR were adjusted for age, sex, smoking and diabetes.

‡ $> 130/85$ mmHg.

§ BMI ≥ 23.0 kg/m².

|| Waist circumference > 90 cm in males and > 80 cm in females.

¶ ≥ 6.11 mmol/l.

†† TAG ≥ 1.7 mmol/l.

‡‡ < 1.0 mmol/l in males and < 1.3 mmol/l in females.

Such food is higher in energy⁽¹⁶⁾, saturated fat, Na⁽¹⁷⁾ and sugar content⁽¹⁸⁾, and lower in Ca, fibre, Fe and vitamin content⁽¹⁷⁾. The recognition that foods prepared outside the home are more energy dense and less healthful than those prepared at home may motivate individuals to modify their dining-out behaviour.

Dining out may become a major determinant of nutritional problems if the trend towards eating outside the home continues. According to the 2001 KNHANES, the percentage of people who ate outside the home more than once per d increased from 20.5 % in 1998 to 33.2 % in 2001⁽²⁾. Here, we showed that the percentage of Korean adults who dined out once or more per week was 70.1%. We also found that older respondents and respondents with diabetes dined out less frequently. This suggests that both ageing and perception of health risk, related to diabetes, influence dining-out behaviour. A report by Kim *et al.*⁽¹⁹⁾ has suggested that individuals who perceive themselves to be susceptible to diseases are more likely to engage in healthy behaviour. In the present study, subjective body image influenced dining-out behaviour, but BMI did not. Factors that influence restaurant choices and dietary intake outside the home depend on the characteristics of diners⁽²⁰⁾. According to Kang *et al.*⁽²⁾ and Kim⁽²¹⁾, when dining out, people select their meals based on preferences (41.4%) and taste (29.8%). Kang *et al.*⁽²⁾ found that nutrition and family recommendations are not influential factors in any age group. However, several studies have shown that older people are more likely to select meals based on recommendations from others, such as family members, social inputs and social/economic reasons, rather than based on their own preferences⁽²²⁾. Therefore, the food selected at different types of restaurants could determine the implications of eating outside the home, in terms of dietary intake and metabolic syndrome risk. When dining out, people should attempt to modify their dining behaviour. For example, they can choose less energy-dense foods and reduce portion sizes, the frequency of snacks, and dietary fat⁽²³⁾. According to a report by Zarkin *et al.*⁽²⁴⁾ and Hyon & Kim⁽²⁵⁾, proper use of nutrition labelling is one of the important tools that

change dietary behaviour of individuals by proper food choices, and influence to reduce obesity. Based on this finding, we could conjecture that using nutrition labelling through proper education is more important than recognition only. Also, consumers should consider their frequency of dining out and how their favourite dish is healthy.

As the global prevalence of the metabolic syndrome has increased with the frequency of dining out, it is important to develop tips for selecting healthy meals away from home and to teach healthy eating patterns. Larson *et al.*⁽²⁶⁾ reported that nutritionally imbalanced meals prepared outside the home may have a considerable influence on health, as well as overall diet quality. The strength of the present study is that it was the first study to determine the nutritional effects of dining out, and to investigate the associations between dining out and metabolic syndrome risk factors. We also reported that a large percentage of Korean adults who dine out have problematic nutritional intakes; more studies on this subject are warranted. Individuals who dine out can use the KDRI to assess the nutritional composition of menus. However, we analysed the answers to a KNHANES questionnaire that addressed dining-out behaviour. Unfortunately, the survey did not include the detailed information about dining-out patterns such as type of restaurants, menu, price and brands. So we could not analyse more profoundly the dining-out patterns of Korean adults. This may limit the interpretation of the present results. Another possible limitation was the use of the 24 h dietary recall for estimating nutrition intake. Memory errors may result in over- or under-reporting of food intake, which may have an impact on the accuracy of our data.

We also discussed the current status of dining-out behaviour measurement and evaluation. In doing so, we sought to identify high-risk groups; further studies will be conducted to develop effective solutions that target dining-out behaviour. Relevant policies may include implementation of expanded nutrition labelling in Korea and behavioural modification strategies that help people modify their eating and physical activity behaviours.

The present study suggests that dining-out behaviour in Korea should be modified. Dining out less frequently or choosing nutritionally balanced meals may protect against metabolic syndrome risk factors. The present study may provide individuals who dine out and health educators with useful insights for modifying dining-out behaviour. The present study also provides a baseline that will inform intervention programmes, and can be used to assess future trends in the relationship between the nutritional quality of meals prepared outside the home and the risk of metabolic diseases.

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